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Ishimaru

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(54) **ELECTRICAL CONNECTOR**

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H01R 12/70 (2011.01)
H01R 12/77 (2011.01)

(52) **U.S. Cl.**
CPC ***H01R 12/7029*** (2013.01); ***H01R 12/774*** (2013.01)

(58) **Field of Classification Search**
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USPC 439/494, 458, 450, 260, 325, 328
See application file for complete search history.

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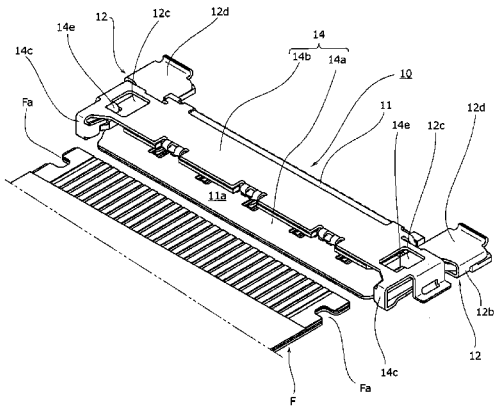
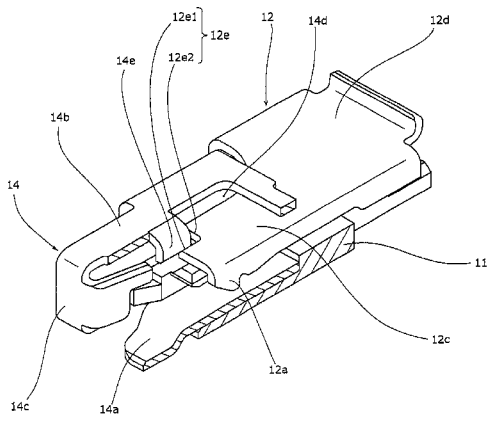
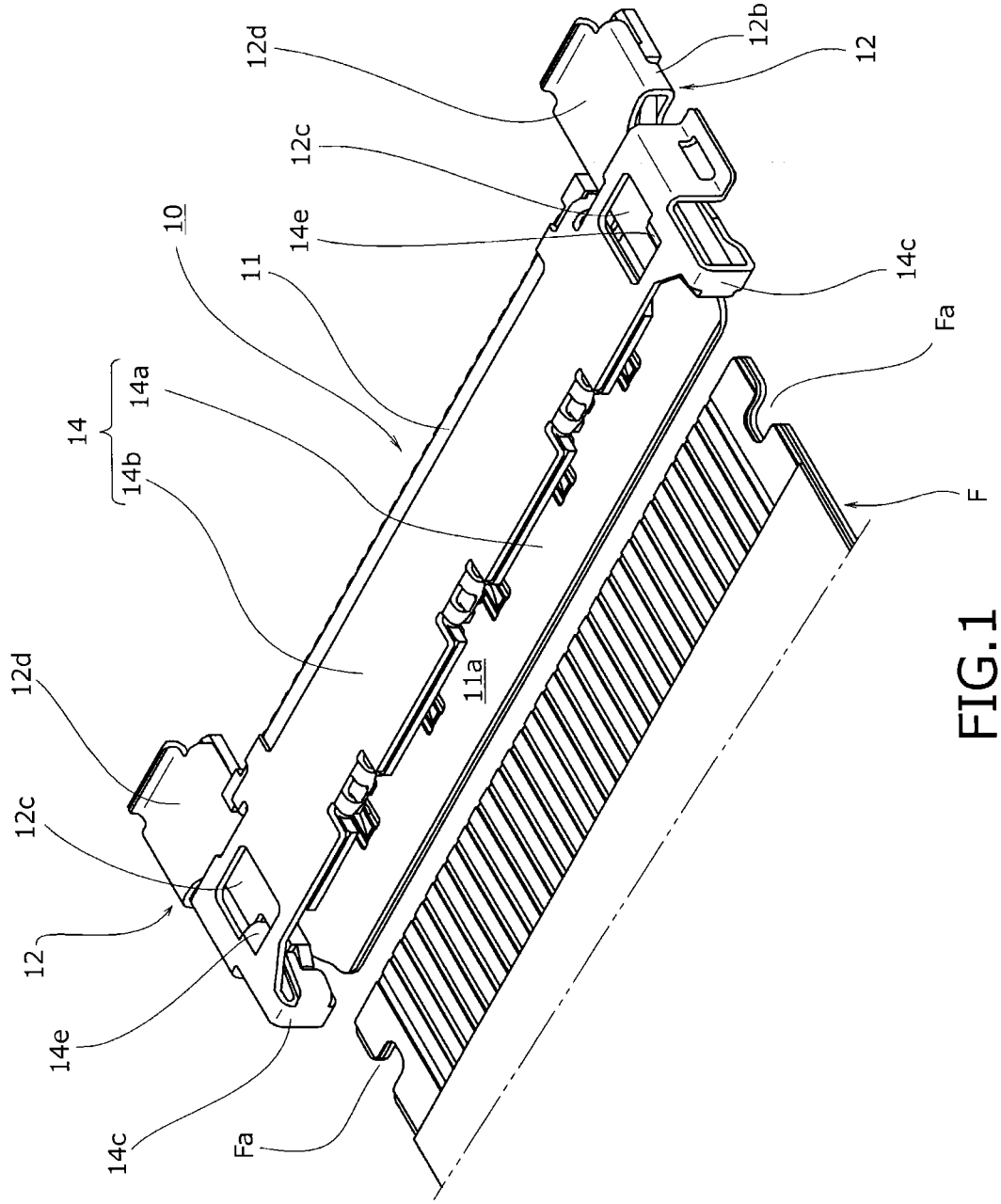
(57) **ABSTRACT**

A lock-arm regulating part, which carries out regulation so that a latch lock claw for carrying out specified movement so as to be engaged with or detached from a signal transmission medium inserted in an insulating housing does not carry out non-constant movement different from the specified movement, is provided. The lock-arm regulating part is disposed to be opposed to the lock arm member in two directions including an insertion/removal direction of the signal transmission medium and an insertion/removal orthogonal direction. Since this configuration is employed, when non-constant external force such as pulling force in a direction different from the original insertion/removal direction is applied to the signal transmission medium, part of the lock arm member is configured to abut the lock-arm regulating part and prevent non-constant movement of the latch lock claw.

5 Claims, 13 Drawing Sheets



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12b
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FIG.1

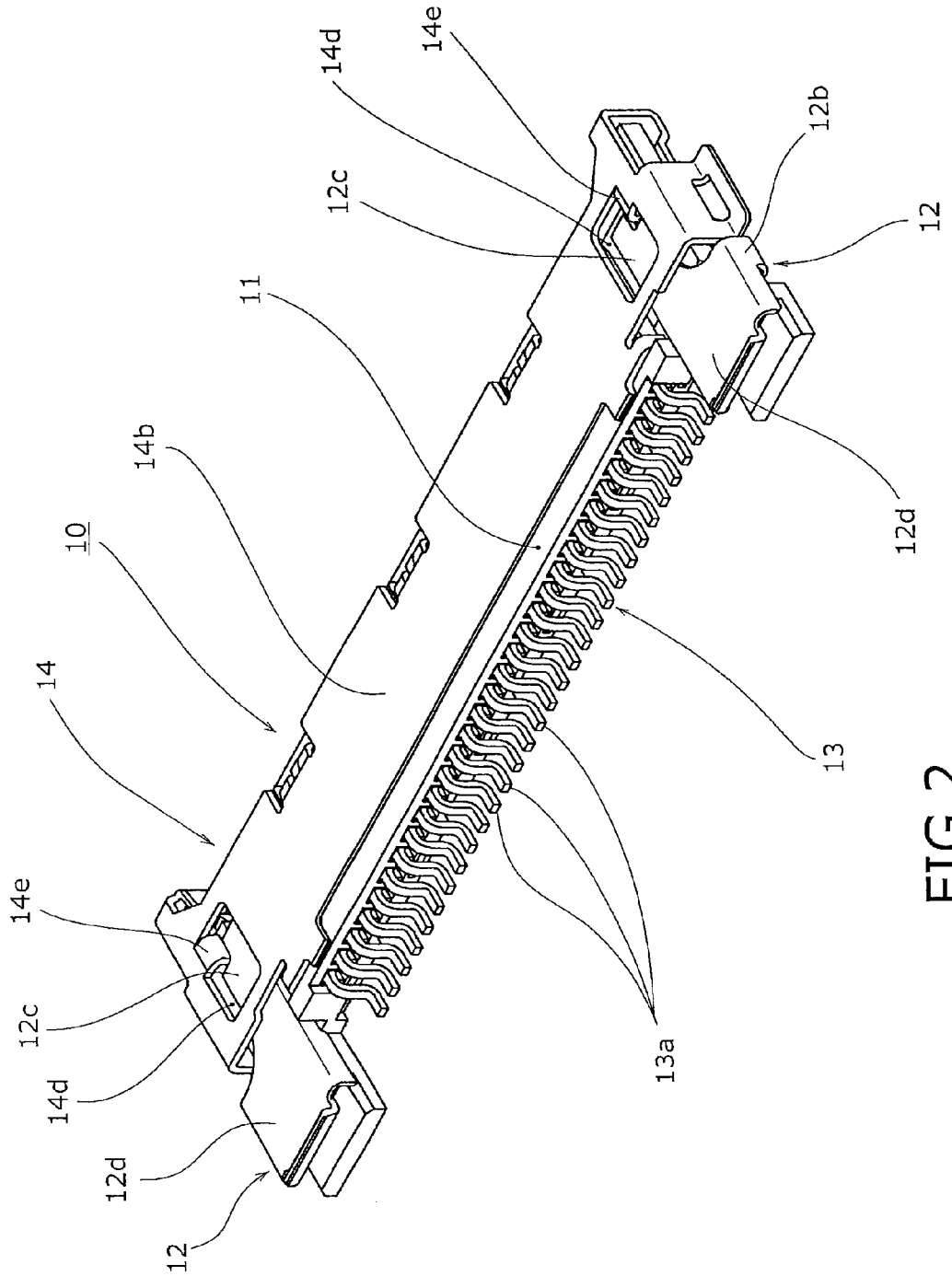

FIG.2

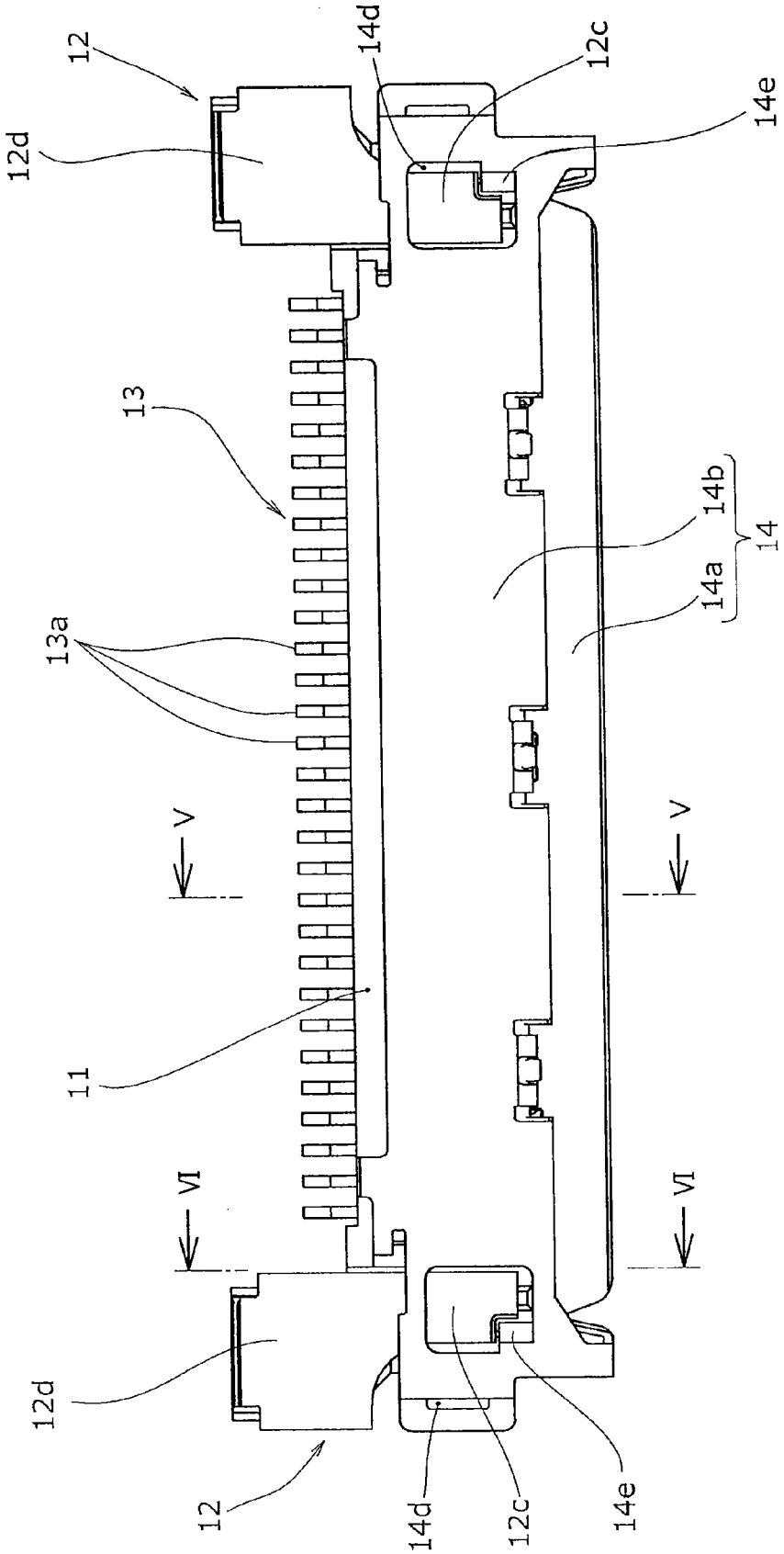

FIG.3

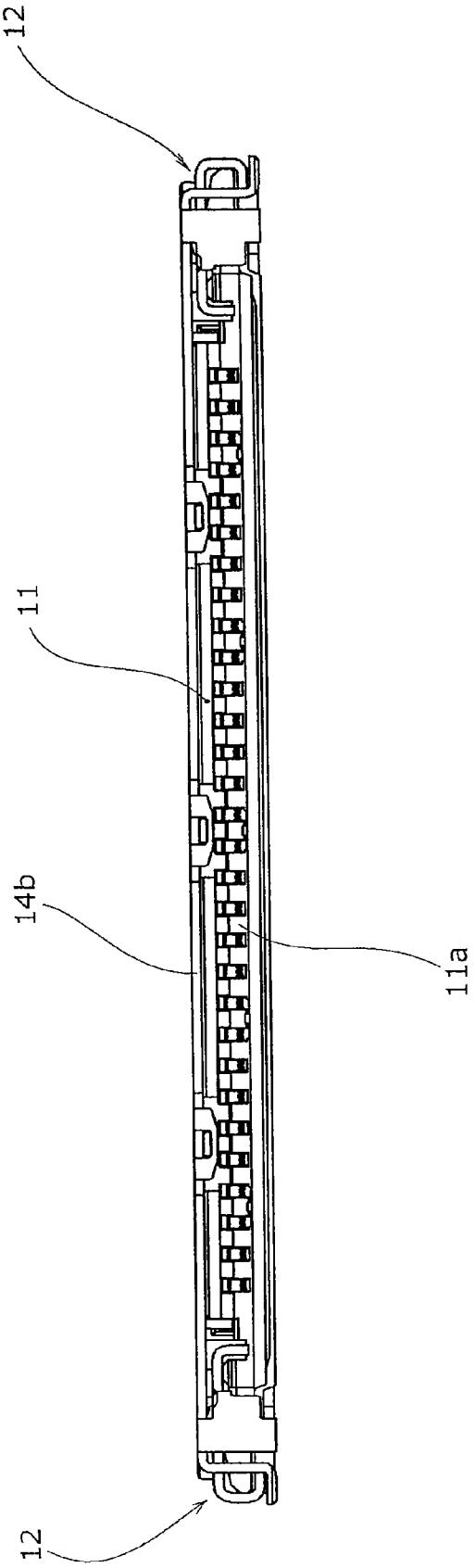

FIG.4

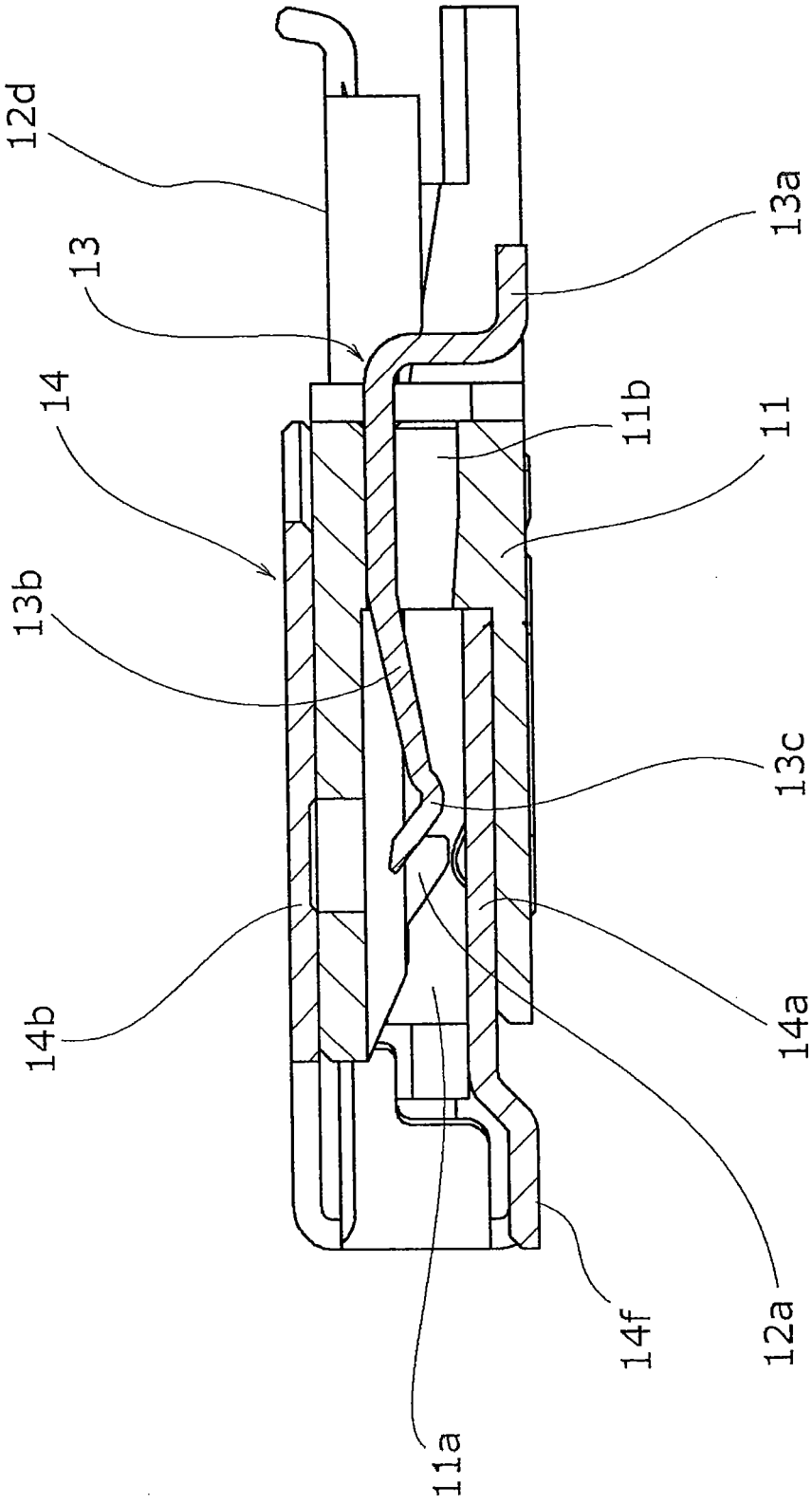

FIG.5

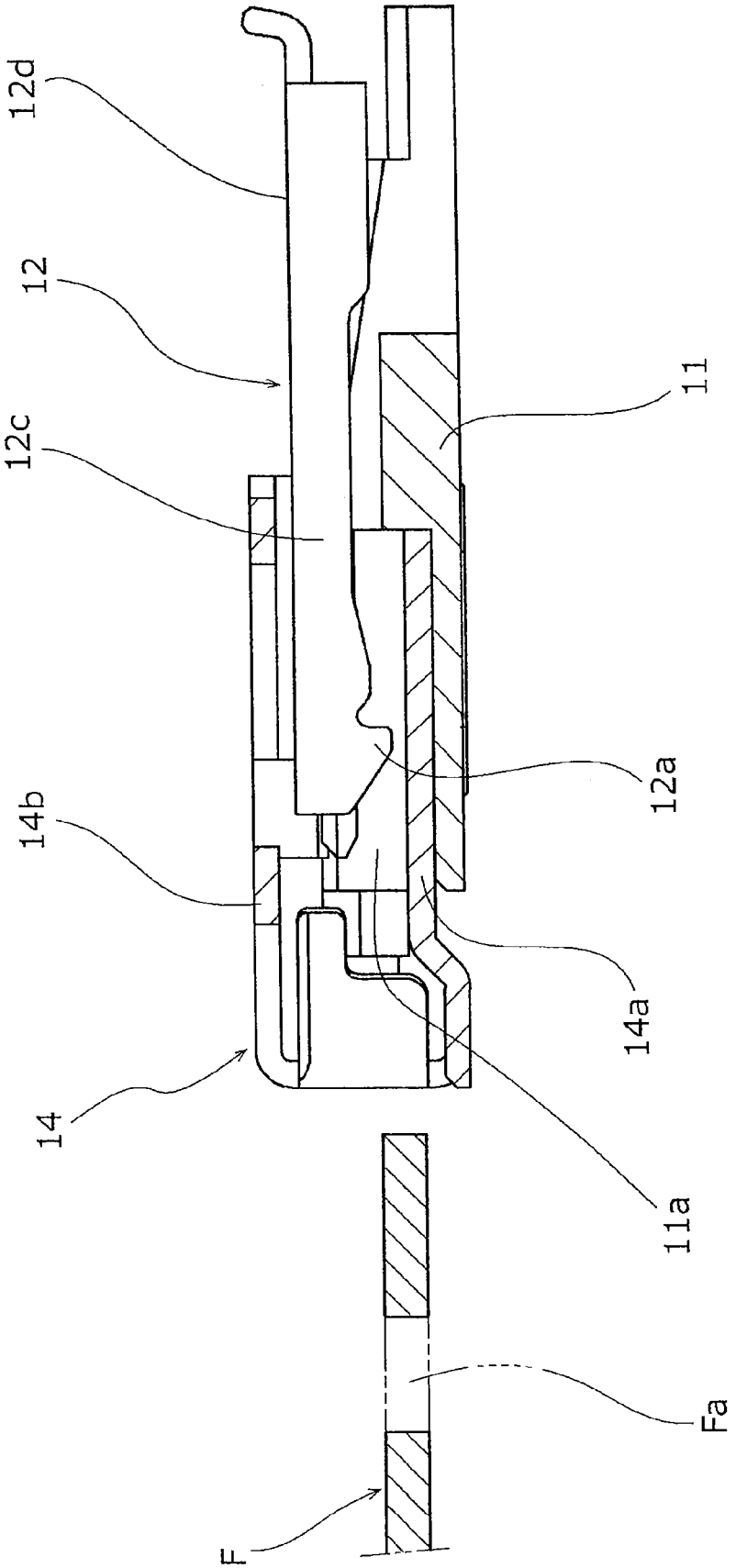

FIG.6

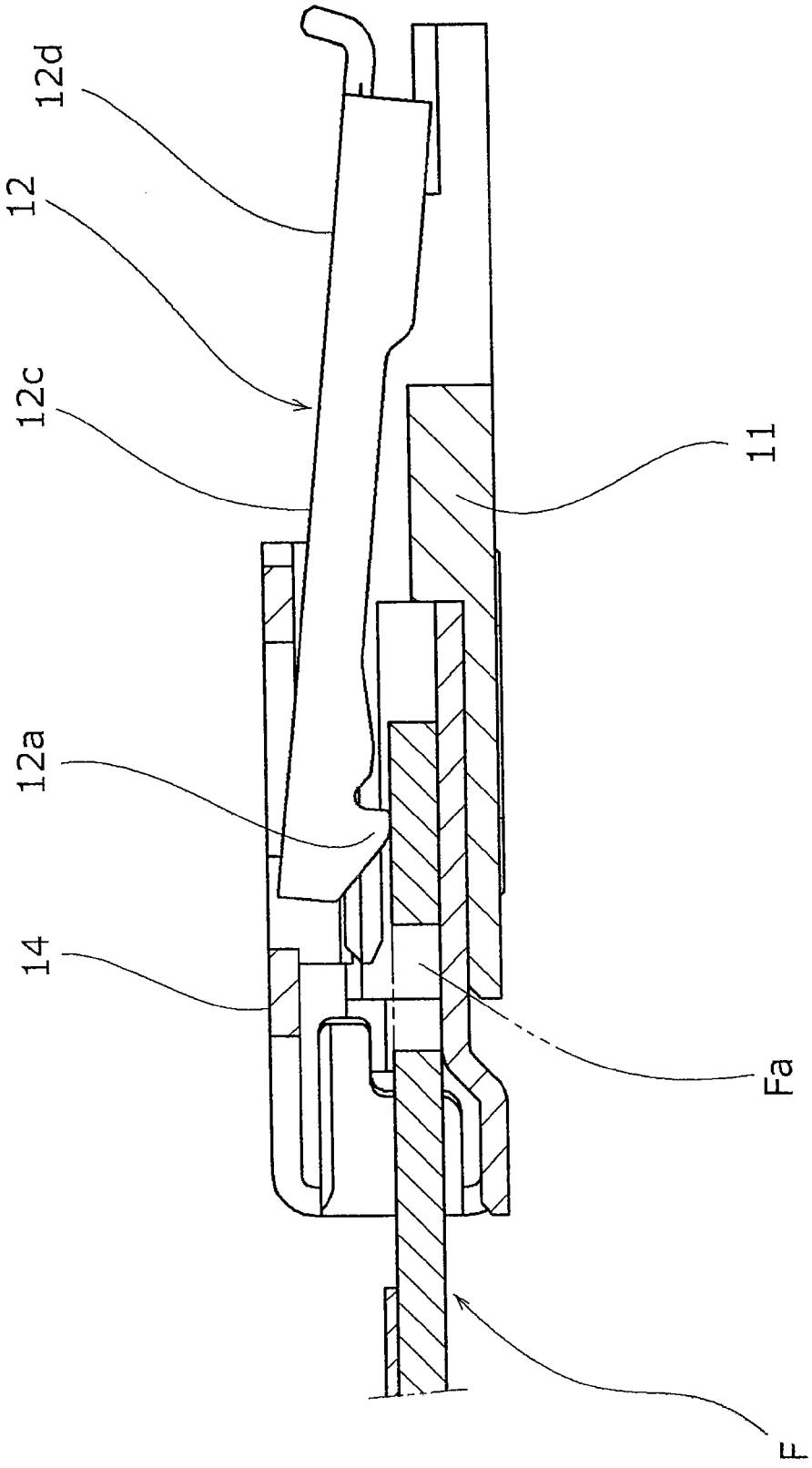

FIG. 7

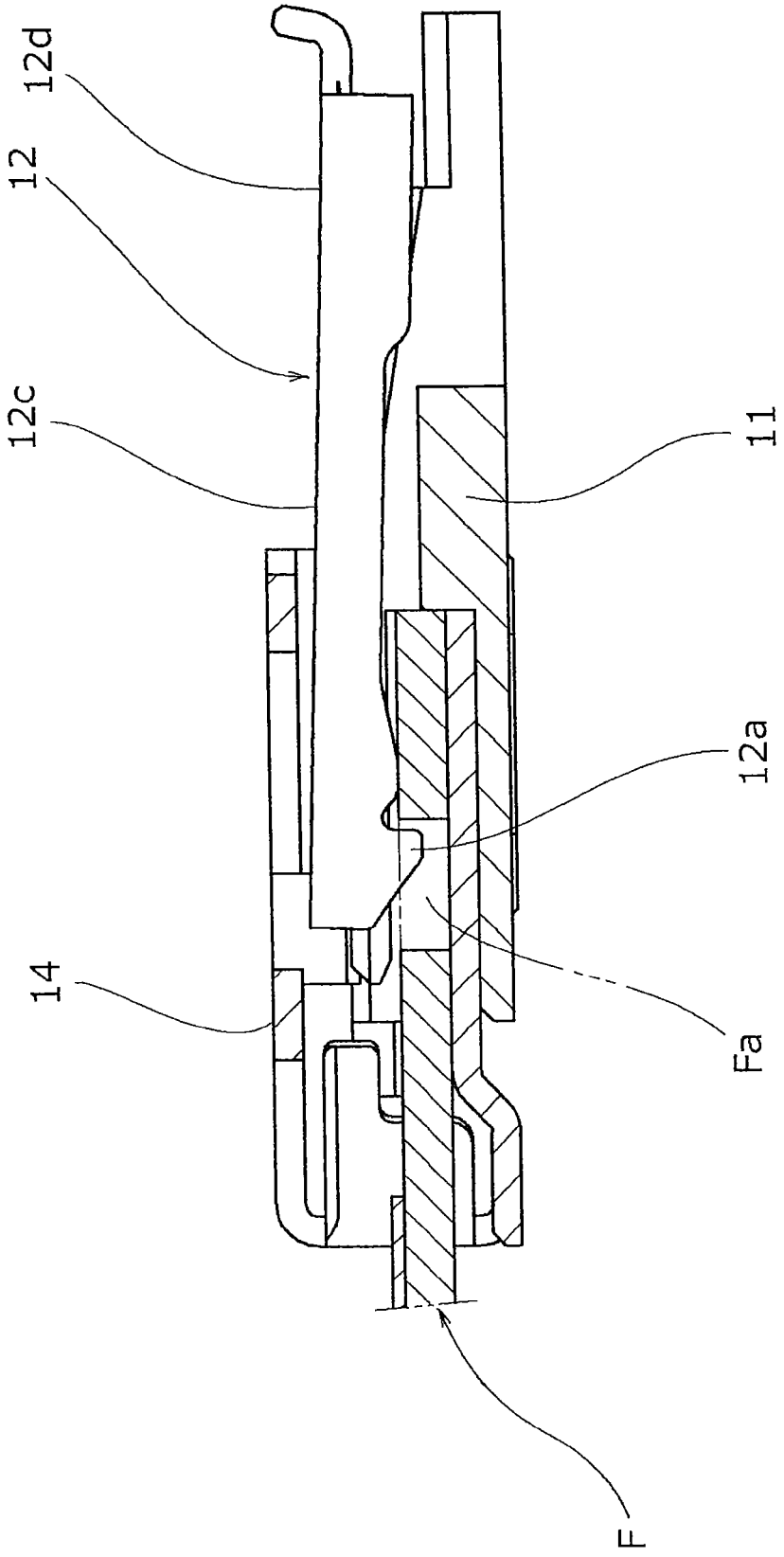

FIG.8

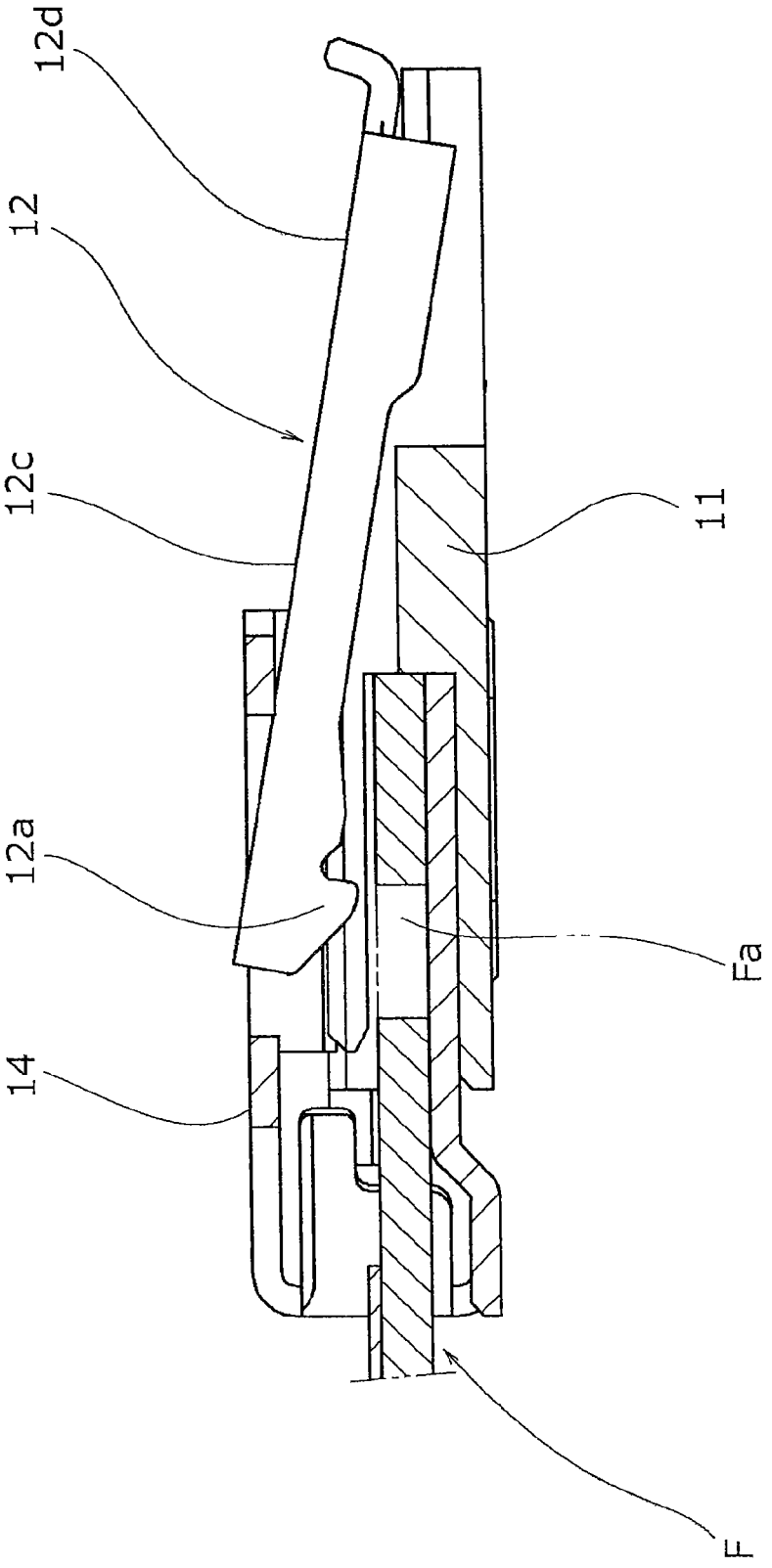

FIG.9

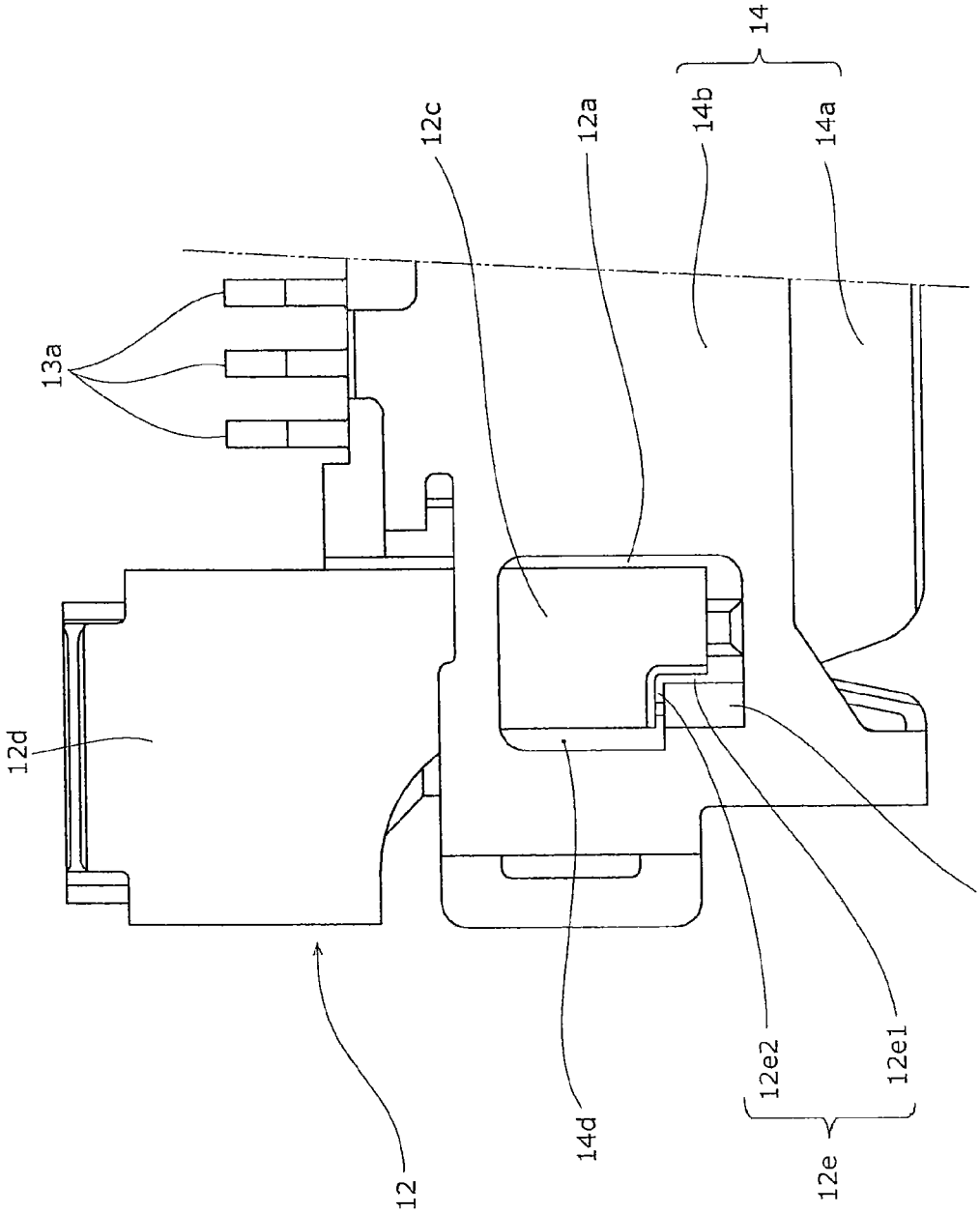

FIG.10

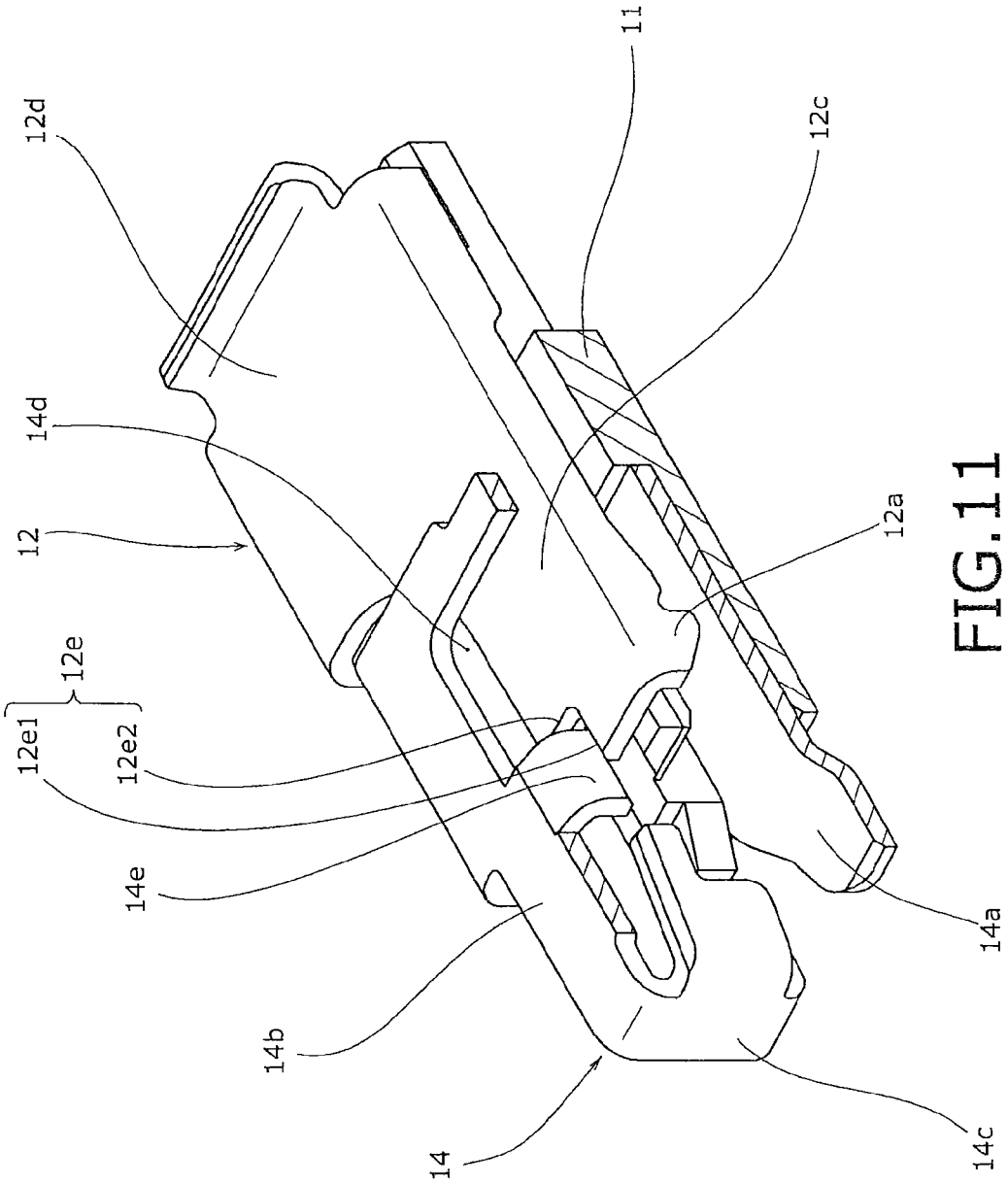

FIG. 11

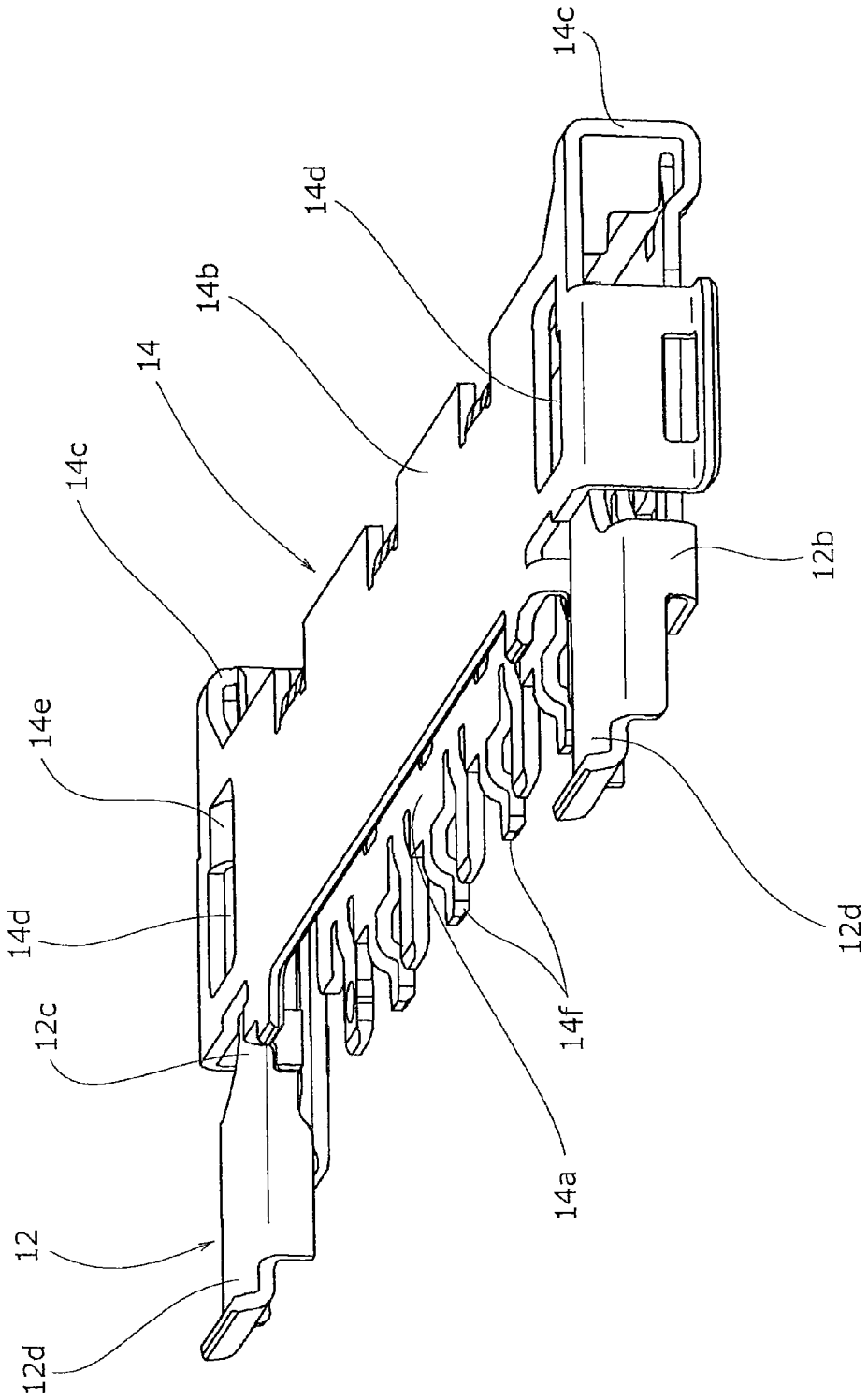

FIG.12

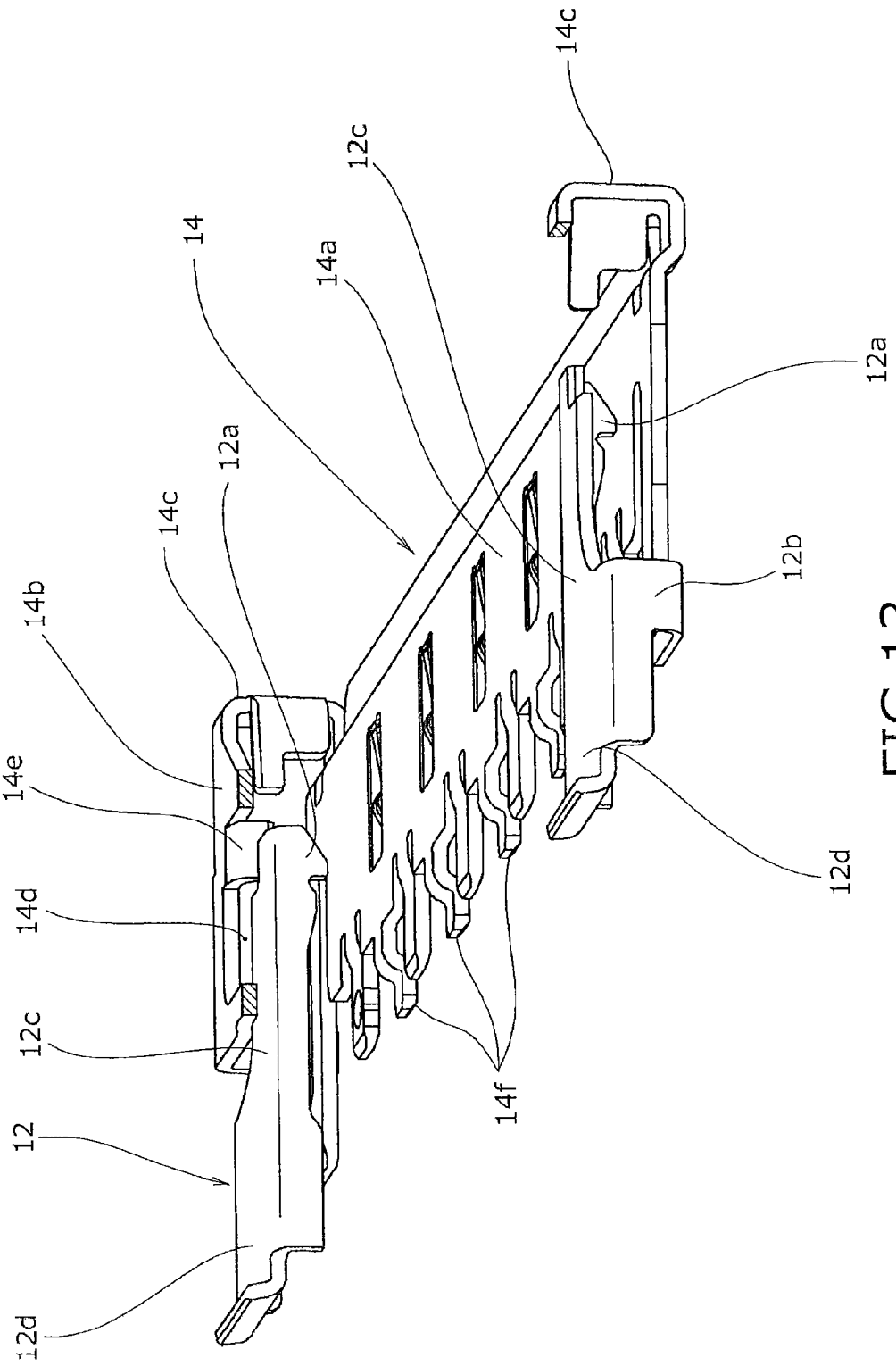

FIG. 13

ELECTRICAL CONNECTOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an electrical connector configured to retain a signal transmission medium when a latch lock claw is engaged with the signal transmission medium inserted in an insulating housing.

2. Description of Related Art

Generally, in various electric devices, etc., as means for electrically connecting various signal transmission media such as flexible printed circuits (FPC) and flexible flat cables (FFC), various electrical connectors are widely used. For example, as electrical connectors used by being mounted on printed wiring boards like Japanese Patent Application Laid Open No. 2011-108500 and Japanese Patent Application Laid Open No. 2011-108501, those employing a so-called one-action auto-lock mechanism have been recently used. In such a lock mechanism, a latch lock claw elastically displaceably supported by a lock arm member is placed on the surface of the signal transmission medium comprised of a FPC, FFC, or the like inserted in a front-end-side opening of the insulating housing (insulator) and is displaced; and, then, engagement is carried out so that part of the latch lock claw is dropped in an engagement part of the signal transmission medium. When the electrical connector provided with the one-action auto-lock mechanism having this configuration is used, the signal transmission medium is retained in an approximately it mobile state only by inserting the signal transmission medium to a predetermined position in the electrical connector, and work efficiency is improved.

As described above, the electrical connector provided with the one-action auto-lock mechanism has an advantage that lock is carried out only by inserting the signal transmission medium (FPC, FFC, or the like) in the electrical connector. However, if external force is applied in a non-constant direction, for example, if the signal transmission medium (FPC, FFC, or the like) inserted in the insulating housing is pulled in a direction different from the original insertion/removal direction, the lock arm member may be elastically displaced toward a non-constant direction shifted from a specified moving direction by the non-constant external force, and the electrical connector may be damaged or broken, for example, the lock arm member may be plastically deformed.

SUMMARY OF THE INVENTION

Therefore, it is an object of the present invention to provide an electrical connector that well prevents the risks of damage and breakage such as plastic deformation of a lock arm member and can improve usage durability with a simple configuration.

In order to achieve the above described object, the present invention employs a configuration that has an insulating housing into/from which a signal transmission medium is inserted or removed, the electrical connector configured to retain or release the signal transmission medium when a latch lock claw supported by an elastically displaceable lock arm member carries out specified movement so as to be engaged with or detached from the signal transmission medium inserted in the insulating housing; wherein a lock-arm regulating part that regulates non-constant movement different from the specified movement of the latch lock claw is provided; and the lock-arm regulating part is disposed to be opposed to part of the lock arm member in two directions including an insertion/removal direction in which insertion or removal of the signal transmission medium is carried out and an insertion/removal orthogonal direction orthogonal thereto.

According to the present invention having such a configuration, when non-constant external force such as pulling force in a direction different from the original insertion/removal direction is applied to the signal transmission medium inserted in the insulating housing, part of the lock arm member elastically displaced in a non-constant direction by the non-constant external force abuts the lock-arm regulating part, thereby preventing non-constant movement of the latch lock claw.

Moreover, according to the present invention, it is desired that the lock-arm regulating part be formed by bending of part of an electrically-conductive shell attached so as to cover the insulating housing.

According to the present invention having such a configuration, the lock-arm regulating part is efficiently manufactured together with the electrically-conductive shell.

Moreover, according to the present invention, it is desired that bending of the lock-arm regulating part be carried out along a bending axis extending approximately in parallel with the insertion/removal direction; and part of the lock arm member abutting the lock-arm regulating part have an insertion/removal-direction abutting surface disposed to be opposed to an end face of the lock-arm regulating part in the extending direction of the bending axis.

In the present invention having such a configuration, when pulling force is applied to the signal transmission medium, the acting force the lock-arm regulating part receives from the lock arm member has a tendency that the component force in the insertion/removal direction becomes larger than the component force in the insertion/removal orthogonal direction. Therefore, the insertion/removal-direction abutting surface of the lock arm member is effectively received by the end face of the lock-arm regulating part having larger strength, the actual strength of the lock-arm regulating part is increased, and the lock-arm regulating part can be downsized.

Moreover, according to the present invention, it is desired that the latch lock claw be integrally formed with an extending-direction first-end-side part of the lock arm member; and a second-end-side part of the lock arm member be integrally continued to an unlock operating part that detaches the latch lock claw from the signal transmission medium.

According to the present invention having such a configuration, a series of members from the unlock operating part to the lock arm member and the latch lock claw are integrated. Therefore, efficient manufacturing can be carried out.

Moreover, in the present invention, it is desired that the latch lock claw have an arrangement relation that the position of the latch lock claw is shifted in the insertion/removal orthogonal direction with respect to a supporting point of a case in which the lock arm member is elastically displaced by removal of the signal transmission medium.

In the arrangement relation of the present invention having such a configuration, when non-constant force such as pulling force in a direction other than the original insertion/removal direction is applied to the signal transmission medium inserted in the insulating housing, the latch lock claw tries to carry out rotary movement with respect to the supporting point at which elastic displacement of the lock arm member is carried out. Also in this case, part of the lock arm member abuts the lock-arm regulating part, thereby preventing rotary movement of the latch lock claw and reducing the risks of damage and breakage of the electrical connector.

As described above, the electrical connector according to the present invention employs a configuration provided with the lock-arm regulating part that regulates non-constant

movement different from the specified movement of the latch lock claw, which carries out the specified movement so as to be engaged with or detached from the signal transmission medium inserted in the insulating housing, and the lock-arm regulating part is disposed so as to be opposed to the lock arm member in the two directions including the insertion/removal direction of the signal transmission medium and the insertion/removal orthogonal direction. Therefore, when non-constant external force such as pulling force in a direction different from the original insertion/removal direction is applied to the signal transmission medium inserted in the insulating housing, part of the lock arm member is configured to abut the lock-arm regulating part and prevent non-constant movement of the latch lock claw. Therefore, with the simple configuration, the risks of damage and breakage such as plastic deformation of the lock arm member can be well prevented, and usage durability of the electrical connector can be significantly improved at low cost.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an external perspective explanatory drawing showing, from the front side, a state immediately before a signal transmission medium such as FPC or FFC is inserted in an electrical connector according to a first embodiment of the present invention;

FIG. **2** is an external perspective explanatory drawing showing, from the back side, the electrical connector shown in FIG. **1**;

FIG. **3** is a plan explanatory drawing of the electrical connector shown in FIG. **1** and FIG. **2**;

FIG. **4** is a front explanatory drawing of the electrical connector shown in FIG. **1** and FIG. **2**;

FIG. **5** is a transverse sectional explanatory drawing taken along a line V-V in FIG. **3**;

FIG. **6** is a transverse sectional explanatory drawing taken along a line VI-VI in FIG. **3** and showing a state immediately before the signal transmission medium is inserted in the electrical connector according to the first embodiment of the present invention;

FIG. **7** is a transverse sectional explanatory drawing corresponding to FIG. **6** showing an intermediate stage of a process in which the signal transmission medium is inserted in the electrical connector according to the first embodiment of the present invention;

FIG. **8** is a transverse sectional explanatory drawing corresponding to FIG. **6** showing a state in which the signal transmission medium is further inserted and locked from the insertion intermediate stage of FIG. **7**;

FIG. **9** is a transverse sectional explanatory drawing corresponding to FIG. **6** showing a state in which an unlocking operation is carried out in the locked state of FIG. **8**;

FIG. **10** is a partial planar explanatory drawing showing a lock mechanism provided at a longitudinal-direction one-side end part of the electrical connector shown in FIG. **3**;

FIG. **11** is a cross-sectional perspective explanatory drawing showing a structure of the lock mechanism shown in FIG. **10**;

FIG. **12** is an external perspective view explanatory drawing showing, from a planar side, a single electrically-conductive shell used in the electrical connector according to the first embodiment of the present invention; and

FIG. **13** is an external perspective explanatory drawing showing a state in which an upper-surface-side member is removed from the electrically-conductive shell shown in FIG. **12**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Hereinafter, an embodiment in which the present invention is applied to an electrical connector, which is used by being mounted on a wiring board in order to establish electrical connection of a signal transmission medium comprised of a flexible printed circuit (FPC), a flexible flat cable (FFC), or the like, will be explained in detail based on drawings.

[About Overall Configuration of Electrical Connector According to First Embodiment]

An electrical connector **10** according to an embodiment of the present invention shown in FIG. **1** to FIG. **13** is comprised of an electrical connector of a NON-ZIF type provided with a so-called one-action auto-lock mechanism and is configured to automatically lock the signal transmission medium F when a terminal part of the above described signal transmission medium (FPC, FFC, or the like) F is inserted to a predetermined position in an insulating housing **11** through a medium insertion opening **11***a* provided at a front edge part (left edge part in FIG. **5**) of the insulating housing **11**.

[About Insulating Housing]

The above described insulating housing **11** is formed of an insulating member having a hollow frame shape extended to form a thin long shape, and a medium insertion path for inserting the signal transmission medium (FPC, FFC, or the like) F is formed in a hollow inner part of the insulating housing **11**. The longitudinal width direction of the insulating housing **11** will be hereinafter referred to as "connector longitudinal direction", and the direction in which insertion or removal of the signal transmission medium (FPC, FFC, or the like) F is carried out will be referred to as "connector front-rear direction" or "medium insertion/removal direction".

At the front edge part (left edge part in FIG. **3**) of the insulating housing **11**, the medium insertion opening **11***a* into which the terminal part of the signal transmission medium F comprised of a flexible printed circuit (FPC), a flexible flat cable (FFC), or the like as described above is provided to form a thin long shape along the connector longitudinal direction. At the connector-longitudinal-direction both-end parts of the insulating housing **11**, which are both-side outer parts of the medium insertion opening **11***a*, lock mechanisms **12** provided with latch lock claws **12***a*, which are engaged with the signal transmission medium (FPC, FFC, or the like) F inserted in the insulating housing **11** are disposed. Furthermore, at rear-end-side parts (right edge parts in FIG. **5**) of the insulating housing **11**, in other words, at opposite-side parts in the connector front-rear direction of the above described medium insertion opening **11***a*, a plurality of part attachment openings **11***b* for attaching electrically-conductive contacts (electrically-conductive terminals) **13**, etc. in the insulating housing **11** are provided with predetermined intervals therebetween along the connector longitudinal direction.

[About Electrically-Conductive Shell]

An electrically-conductive shell **14** is attached to the above described insulating housing **11** so as to cover the almost entire outer surface thereof except the medium insertion opening **11***a* and the part attachment openings **11***b*. Particularly as shown in FIG. **12** and FIG. **13**, the electrically-conductive shell **14** is comprised of a thin-plate-shaped metal member formed by appropriate bending, has a shell bottom surface plate **14***a* having a flat plate shape placed on a main wiring board (illustration omitted), and has a shell upper surface plate **14***b*, which faces thereto approximately in parallel to form a predetermined interval therebetween at a position above the shell bottom surface plate **14***a*. The shell upper surface plate **14***b* has a structure which is integrally coupled

via a shell coupling plate **14***c* formed so as to be raised from longitudinal-direction both-side parts of the front edge of the above described shell bottom surface plate **14***a*.

The shell bottom surface plate **14***a* and the shell upper surface plate **14***b* constituting the electrically-conductive shell **14** in this manner is attached, for example, by press-fitting to the above described insulating housing **11**, and a plurality of board connecting parts **14***f* formed on the shell bottom surface plate **14***a* are solder-joined with shielded electrically-conductive paths (wiring pattern) on the main wiring board (illustration omitted).

At the connector-longitudinal-direction both-side end parts of the electrically-conductive shell **14** formed in this manner, the lock mechanisms **12** including the above described latch lock claws **12***a* are integrally formed. The lock mechanisms **12** in the present embodiment form so-called one-action auto-lock mechanisms as described above, and detailed configurations thereof will be explained in detail later.

[About Electrically-Conductive Contact]

The electrically-conductive contacts **13** are formed of thin-plate-shaped metal members formed by appropriate punching, the plurality of electrically-conductive contacts **13** are inserted from the part attachment openings **11***b*, which are in the rear end side of the above described insulating housing **11**, toward the front side (left side in FIG. **5**), and the plurality of electrically-conductive contacts **13** are disposed to be multipolar and form appropriate intervals therebetween in the connector longitudinal direction in the medium insertion path of the insulating housing **11**. Each of the electrically-conductive contacts **13** is for signal transmission or ground connection and is used in a state that it is mounted by solder-joint with the electrically-conductive path formed on the main printed wiring board (illustration omitted).

Thus, signal-transmission electrically-conductive paths (signal-line pads) or shielded electrically-conductive paths (shielded line pads) are formed at appropriate pitch intervals on the signal transmission medium (FPC, FFC, or the like) F, which is inserted into the insulating housing **11** through the medium insertion opening **11***a*, and the disposed positions of the electrically-conductive contacts **13** attached in the insulating housing **11** in the above described manner are set to correspond to the wiring pattern of the signal transmission medium (FPC, FFC, or the like) F.

The configuration of the electrically-conductive contacts **13** according to the present embodiment will be explained in further detail. The electrically-conductive contacts **13** are formed so as to extend along the connector front-rear direction (medium insertion/removal direction), which is the insertion/detachment direction (left-right direction in FIG. **5**) of the signal transmission medium (FPC, FFC, or the like) F, and the parts projecting from the connector rear end parts of the insulating housing **11** toward the rear side serve as board connecting parts **13***a*, which are solder-joined with the signal-transmission electrically-conductive paths (signal-line pads) formed on the main printed wiring board (illustration omitted). Each of the board connecting parts **13***a* is approximately perpendicularly bent and raised upward from the board connecting part **13***a*, is then approximately perpendicularly bent again in the horizontal direction, and is continued to the base part of a flexible arm part **13***b* comprised of a narrow-long-shaped beam member extending toward the front side.

The flexible arm part **13***b* at this point is extending from the part continued to the above described board connecting part **13***a* so as to form a cantilever structure along an upper inner wall surface of the medium insertion path of the insulating housing **11** and is configured to project obliquely downward toward the front side from an intermediate part thereof. The flexible arm part **13***b* of the electrically-conductive contact **13** having such a configuration has a structure that is swung in the top-bottom direction in the paper surface of FIG. **5** about the part, at which the board connecting part **13***a* is raised from the main printed wiring board (illustration omitted), or a vicinity thereof.

At a front-side extended part (left-end-side part in FIG. **5**) of the flexible arm part **13***b*, a terminal contact projecting part **13***c* is provided so as to form a downward projecting shape in the drawing to correspond to the signal-transmission electrically-conductive path or the shielded electrically-conductive path (wiring pattern) formed on the signal transmission medium (FPC, FFC, or the like) F. Thus, the terminal contact projecting part **13***c* provided in the electrically-conductive contact **13** has an arrangement relation that, when the signal transmission medium F is inserted in the medium insertion path of the insulating housing **11** in the above described manner, the terminal contact projecting part **13***c* is placed over the wiring pattern provided on the signal transmission medium F. The signal transmission medium F is inserted to a predetermined final position in a state in which the terminal contact projecting part **13***c* is in contact therewith with a downward pressure of the elastic force of the flexible arm part **13***b*, wherein an electrically connected state therebetween is configured to be maintained.

[About One-Action Auto-Lock Mechanism]

The lock mechanisms **12** provided in the electrical connector **10** according to the present embodiment form the one-action auto-lock mechanisms as described above. As a condition thereof, engagement position determining parts Fa, Fa comprised of cut-away recessed parts are formed at width-direction both-side edge parts of the terminal part of the signal transmission medium (FPC, FFC, or the like) F particularly as shown in FIG. **1**. The pair of latch lock claws **12***a*, **12***a* constituting the lock mechanisms **12** of the electrical connector **10** side are engaged with the engagement position determining parts Fa, Fa provided in the signal transmission medium F as if they are dropped from the upper side. The latching action (locking action) in this process retains the signal transmission medium F in a final inserted state without being removed.

[About the Latch Lock Claws]

Each of the lock mechanisms **12** including the latch lock claw **12***a* of this case is formed of a bent structure of an integrated thin-plate metal member particularly as shown in FIG. **10** and FIG. **11**, and the lock mechanisms **12** are integrally provided at the connector-longitudinal-direction both end parts so as to form part of the electrically-conductive shell **14** as described above. At the connector-longitudinal-direction both end parts, the lock mechanisms **12** are integrally coupled to the electrically-conductive shell **14** via lock coupling plates **12***b* to the shell bottom surface plate **14***a* of the above described electrically-conductive shell **14**.

The above described lock coupling plates **12***b* are comprised of plate-shaped pieces formed by bending so as to be extended upward approximately perpendicularly from rear end parts of the connector-longitudinal-direction both-side edges of the shell bottom surface plate **14***a*, and lock arm members **12***c* are extended approximately horizontally so as to form cantilever shapes from upper ends of the lock coupling plates **12***b* toward the front side (lower side in FIG. **10**). Moreover, from upper end parts of the lock coupling plates **12***b*, unlock operating parts **12***d* are extended so as to form cantilever shapes approximately horizontally toward the rear (upper side in FIG. **10**).

The lock arm parts **12***c* and the unlock operating parts **12***d* are formed of plate-shaped members integrally continued via the lock coupling plates **12***b*, and each of the lock arm parts **12***c* and the unlock operating parts **12***d* is configured to be swung in the vertical direction about the lock coupling plate **12***b* or a swing supporting point in the vicinity thereof. Therein, in extending-direction front end part of the lock arm parts **12**, the above described latch lock claws **12***a* are integrally provided.

The latch lock claw **12***a* is comprised of a hook-shaped member formed by bending so that a plate-width-direction (connector longitudinal direction) connector-inner-side edge part of the lock arm member **12***c* projects downward and is formed to have an approximately triangular shape in the lateral side thereof. The latch lock claw **12***a* has an inclined guiding side extended obliquely upward from a vertex part in the lower end side thereof toward the front side. Since the latch lock claw **12***a* having such a shape is supported by the lock arm member **12***c* so that it can be elastically displaced, the latch lock claw **12***a* is configured to be moved in the vertical direction along with swing of the lock arm member **12***c*.

When the signal transmission medium (FPC, FFC, or the like) is inserted in the electrical connector **10**, the lower end parts of the latch lock claws **12***a* are placed on the surface of the signal transmission medium F, and, corresponding to that, the lock arm members **12***c* are elastically deformed to be warped upward, thereby obtaining a state in which the latch lock claws **12***a* are displaced to the upper side. Then, when the engagement position determining parts Fa of the signal transmission medium F reach the positions immediately below the latch lock claws **12***a*, the latch lock claws **12***a* are pushed down to be moved toward the inside of the engagement position determining parts Fa by elastic returning force of the lock arm members **12***c*, and, as a result, the latch lock claws **12***a* obtain an engaged state (locked state) with the engagement position determining parts Fa to cause the signal transmission medium F to be in a retained state.

At this point, the shell upper surface plate **14***b* of the electrically-conductive shell **14** is in an arrangement relation in which the shell upper surface plate **14***b* is extended approximately in parallel with the shell bottom surface plate **14***a* with a predetermined interval therebetween, and the connector-longitudinal-direction both end parts of the shell upper surface plate **14***b* are in an arrangement relation in which they are overlapped with the lock arm members **12***c* of the above described lock mechanisms **12** from the upper side in a non-contact state. At connector-longitudinal-direction both end parts of the shell upper surface plate **14***b*, shell through holes **14***d* having approximately rectangular shape in plane are formed to penetrate therethrough at the positions corresponding to the lock arm members **12***c*, and the front end parts of the lock arm members **12***c* are in a state exposed toward the upper side of the connector through the shell through holes **14***d*.

The inner peripheral edge that forms the shell through hole **14***d* provided in the shell upper surface plate **14***b* is formed so as to be approximately rectangular in plane, and lock-arm regulating parts **14***e*, which regulate non-constant movement of the above described latch lock claws **12***a*, are formed at front-side corner parts of the inner peripheral edges of the shell through holes **14***d*. Each of the lock-arm regulating parts **14***e* is provided at the position corresponding to connector-outer-side corner part among the front-side both corner parts of the shell through hole **14***d*, and the lock-arm regulating part **14***e* is formed by a plate-shaped member, which is the shell upper surface plate **14***b* positioned at the corner part caused to project by a predetermined length toward the inner side of the shell through hole **14***d*. In this manner, the lock-arm regulating part **14***e* is formed of a plate-shaped member, which is projecting by a predetermined length in the connector longitudinal direction from the connector-outer-side edge of the shell through hole **14***d* toward the inner side of the shell through hole **14***d*, and the inner-side extended part of the plate-shaped member constituting the lock-arm regulating part **14***e* is bent so as to be curved downward. The bending axis of the bent lock-arm regulating part **14***e* is set to extend in the direction that approximately matches the connector front-rear direction, which is the insertion/removal direction of the signal transmission medium (FPC, FFC, or the like) F.

In this case, the front end part of the above described lock arm member **12***c* has an arrangement relation in which it is close to the lock-arm regulating part **14***e*, and a cut-away abutting part **12***e* disposed to be close to the lock-arm regulating part **14***e* is provided at the front end part of the lock arm member **12***c*. The cut-away abutting part **12***e* is formed to cut away a connector-outer-side corner part among both corner parts of the front end part of the lock arm part **12***c*, in other words, cut away the corner part positioned in the opposite side of the above described latch lock claw **12***a* into an approximately rectangular shape in plane. Two sides constituting the approximately rectangular planar shape of the cut-away abutting part **12***e* have an arrangement relation that they are opposed to the two sides constituting the corner part of the above described lock-arm regulating part **14***e* from the connector inner side with appropriate intervals therebetween.

More specifically, one side among the two sides constituting the above described cut-away abutting part **12***e* is an insertion/removal orthogonal-direction abutting surface **12***e***1** which is approximately parallel to the bending axis of the bent lock-arm regulating part **14***e*, in other words, is extending in the insertion/removal direction (connector front-rear direction) of the signal transmission medium (FPC, FFC, or the like) F. The insertion/removal orthogonal-direction abutting surface **12***e***1** is disposed so as to be close to and opposed to a principal surface owned by the above described lock-arm regulating part **14***e* in the connector longitudinal direction. The other side among the two sides constituting the cut-away abutting part **12***e* is an insertion/removal-direction abutting surface **12***e***2** extending in the direction approximately orthogonal to the bending axis of the lock-arm regulating part **14***e*, and the insertion/removal-direction abutting surface **12***e***2** is disposed so as to be close to and opposed to a bending-axis-direction end face of the lock-arm regulating part **14***e* in the medium insertion/removal direction (connector front-rear direction).

In this case, the insertion/removal orthogonal-direction abutting surface **12***e***1** and the insertion/removal-direction abutting surface **12***e***2** constituting the cut-away abutting part **12***e* of the above described lock arm member **12***c* do not have a positional relation in which they abut the lock-arm regulating part **14***e*, which is provided in the electrically-conductive shell **14** side, in the vertical direction. Therefore, upon movement of the lock arm member **12***c* in the vertical direction, in other words, upon constant movement of the lock arm member **12***c* when the latch lock claw **12***a* is engaged with or detached from the engagement position determining part Fa, Fa of the signal transmission medium (FPC, FFC, or the like) F, constant movement of both of the insertion/removal orthogonal-direction abutting surface **12***e***1** and the insertion/removal-direction abutting surface **12***e***2** is allowed without abutting the lock-arm regulating part **14***e*. On the other hand, in the case of non-constant movement different from the constant movement of the lock arm part **12***c*, in other words, the case in which the lock arm part **12***c* includes a movement

component in the connector longitudinal direction, the insertion/removal orthogonal-direction abutting surface **12***e***1** or the insertion-direction abutting surface **12***e***2** constituting the cut-away abutting part **12***e* of the lock arm part **12***c* abuts the lock-arm regulating part **14***e*, thereby preventing non-constant movement of the lock-arm member **12***c*.

On the other hand, the unlock operating part **12***d* also constituting the lock mechanism **12** is comprised of a plate-shaped member continued to the rear end part of the above described lock arm member **12***c* and is projecting toward the rear side from the shell upper surface plate **14***b* of the above described electrically-conductive shell **14**. When a fingertip of an operator is placed on a flat-surface part of the unlock operating part **12***d* and pushes it downward, the latch lock claw **12***a* is configured to be elastically displaced to the upper side together with the above described lock arm member **12***c*.

At this point, at a position below the unlock operating part **12***d*, part of the bottom plate of the insulating housing **11** is disposed to face thereto and is configured to have a stopper function of a case in which the unlock operating part **12***d* is pushed downward.

The state from insertion to engagement of the signal transmission medium (FPC, FFC, or the like) F will be explained in detail. First, as shown in FIG. **6** to FIG. **7**, when the signal transmission medium F is inserted in the medium path of the insulating housing **11** through the medium insertion opening **11***a* of the insulating housing **11**, the insertion-side distal edge part of the signal transmission medium F abuts the inclined guiding part of the latch lock claw **12***a*, and the latch lock claw **12***a* is placed on the surface of the signal transmission medium F. As a result, the lock arm member **12***c* supporting the latch lock claw **12** is elastically displaced so as to be pushed to the upper side about the lock coupling plate **12***b* or the swing supporting point in the vicinity thereof. The terminal part of the signal transmission medium F is further pushed in this state toward the rear side; and, then, when the engagement position determining part Fa of the signal transmission medium F is moved to the position immediately below the latch lock claw **12***a*, as shown in FIG. **8**, the latch lock claw **12***a* is moved so as to be pushed into the engagement position determining part Fa of the signal transmission medium F by the elastic returning force of the lock arm member **12***c*. As a result, the latch lock claw **12***a* becomes an engaged state with the engagement position determining part Fa of the signal transmission medium F, and the signal transmission medium F is retained so that it is not removed therefrom.

On the other hand, when an unlocking operation in which the unlock operating part **12***d* is pushed down by the operator as shown in FIG. **9** is carried out in the state in which the latch lock part **12***a* is engaged with the engagement position determining part Fa of the signal transmission medium F, the latch lock claw **12***a* is moved to the upper side against the elastic force of the lock arm member **12***c*, the latch lock claw **12***a* is detached from the engagement position determining part Fa of the signal transmission medium F, and the engaged state (locked state) of the latch lock claw **12** is cancelled.

In the present embodiment having such a configuration, when non-constant external force such as pulling in a direction different from the original insertion/removal direction is applied to the signal transmission medium (FPC, FFC, or the like) F retained by the latch lock claw **12***a* by insertion into the insulating housing **11**, the lock arm member **12***c* is also elastically displaced in a non-constant direction by the non-constant external force, and the insertion/removal orthogonal-direction abutting surface **12***e***1** or the insertion/removal-direction abutting surface **12***e***2** of the cut-away abutting part **12***e* provided at the front end part of the lock arm member **12***c* abuts the lock-arm regulating part **14***e*, thereby preventing non-constant movement of the lock arm member **12***c* and the latch lock claw **12***a* and reducing the risks of damage and breakage of the electrical connector **10**.

When pulling force is applied to the signal transmission medium (FPC, FFC, or the like) F, the acting force the lock-arm regulating part **14***e* receives from the lock arm member **12***c* has a tendency that the component force in the insertion/removal direction becomes larger than the component force in the insertion/removal orthogonal direction. Regarding such a situation, in the present embodiment, the insertion/removal-direction abutting surface **12***e***2** constituting the cut-away abutting part **12***e* of the lock arm member **12***c* is disposed so as to face the bending-axis-direction end face of the lock-arm regulating part **14***e*. Thus, the insertion/removal-direction component force having larger acting force is configured to be received by the lock-arm regulating part **14***e* having larger strength; therefore, the actual strength of the lock-arm regulating part **14***e* is increased, and the lock-arm regulating part **14***e* can be downsized.

In this case, the lock-arm regulating part **14***e* according to the present embodiment is formed by bending part of the electrically-conductive shell **14**. Therefore, the lock-arm regulating part **14***e* is configured to be efficiently manufactured together with the electrically-conductive shell **14**.

Furthermore, in the present embodiment, the part from the latch lock claw **12***a* integrally formed with an extending-direction first-end-side part of the lock arm member **12***c* to the unlock operating part **12***d* provided at a second-end-side part of the lock arm member **12***c* is integrally continued, and the series of members from the unlock operating part **12***d* to the lock arm member **12***c* and the latch lock claw **12***a* are integrated; therefore, efficient manufacturing can be carried out.

Furthermore, in the present embodiment, with respect to the supporting point of the case in which the lock arm member **12***c* is elastically displaced by removal of the signal transmission medium (FPC, FFC, or the like) F, the latch lock claw **12***a* has an arrangement relation in which the position of the latch lock claw **12***a* is shifted in the insertion/removal orthogonal direction. Therefore, when non-constant external force is applied, for example, since the signal transmission medium (FPC, FFC, or the like) F is pulled in a direction different from the original insertion/removal direction, the latch lock claw **12***a* tries to carry out rotary movement with respect to the supporting point of the elastic displacement of the lock arm member **12***c*. However, also in this case, the insertion/removal orthogonal-direction abutting surface **12***e***1** or the insertion-direction abutting surface **12***e***2** constituting the cut-away abutting part **12***e* of the lock arm member **12***c* abuts the lock-arm regulating part **14***e*, thereby preventing the rotary movement of the latch lock claw **12***a* and reducing the risks of damage and breakage of the electrical connector.

Hereinabove, the invention accomplished by the present inventor has been explained in detail based on the embodiment. However, the present invention is not limited to the above described embodiment, and it goes without saying that various modifications can be made within a range not departing from the gist thereof.

For example, in the above described embodiment, the flexible printed circuit (FPC) and the flexible flat cable (FFC) are employed as the signal transmission medium fixed to the electrical connector. However, the present invention can be similarly applied also to a case in which other signal transmission media, etc. are used.

Furthermore, in the electrical connector according to the above described embodiment, the electrically-conductive contacts having the same shapes are used. However, the

present invention can be similarly applied even to a structure in which electrically-conductive contacts having different shapes are alternately disposed.

The present invention can be widely applied to various electrical connectors used in various electrical devices.

What is claimed is:

1. An electrical connector comprising;

an insulating housing into/from which a signal transmission medium is inserted or removed,

the electrical connector configured to retain or release the signal transmission medium when a latch lock claw supported by an elastically displaceable lock arm member carries out specified movement so as to be engaged with or detached from both side edges in the width direction of the signal transmission medium inserted in the insulating housing; wherein

a lock-arm regulating part that regulates non-constant movement different from the specified movement of the latch lock claw is provided; and

the lock-arm regulating part is disposed to be opposed to an insertion/removal-direction abutting surface and an insertion/removal orthogonal-direction abutting surface which are formed by a cut away part of the lock arm member in two directions including an insertion/removal direction in which insertion or removal of the signal transmission medium is carried out and the width direction of the signal transmission medium that is an insertion/removal orthogonal direction orthogonal thereto.

2. The electrical connector according to claim **1**, wherein the lock-arm regulating part is formed by bending of part of an electrically-conductive shell attached so as to cover the insulating housing.

3. The electrical connector according to claim **2**, wherein bending of the lock-arm regulating part is carried out along a bending axis extending approximately in parallel with the insertion/removal direction; and the insertion/removal-direction abutting surface disposed to be opposed to an end face of the lock-arm regulating part in the extending direction of the bending axis.

4. The electrical connector according to claim **1**, wherein the latch lock claw is integrally formed with an extending-direction first-end-side part of the lock arm member; and a second-end-side part of the lock arm member is integrally continued to an unlock operating part that detaches the latch lock claw from the signal transmission medium.

5. The electrical connector according to claim **1**, wherein the latch lock claw has an arrangement relation that the position of the latch lock claw is shifted in the insertion/removal orthogonal direction with respect to a supporting point of a case in which the lock arm member is elastically displaced by removal of the signal transmission medium.

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